Monitoring O_3 and Aerosols with the NASA LaRC Mobile Ozone Lidar System

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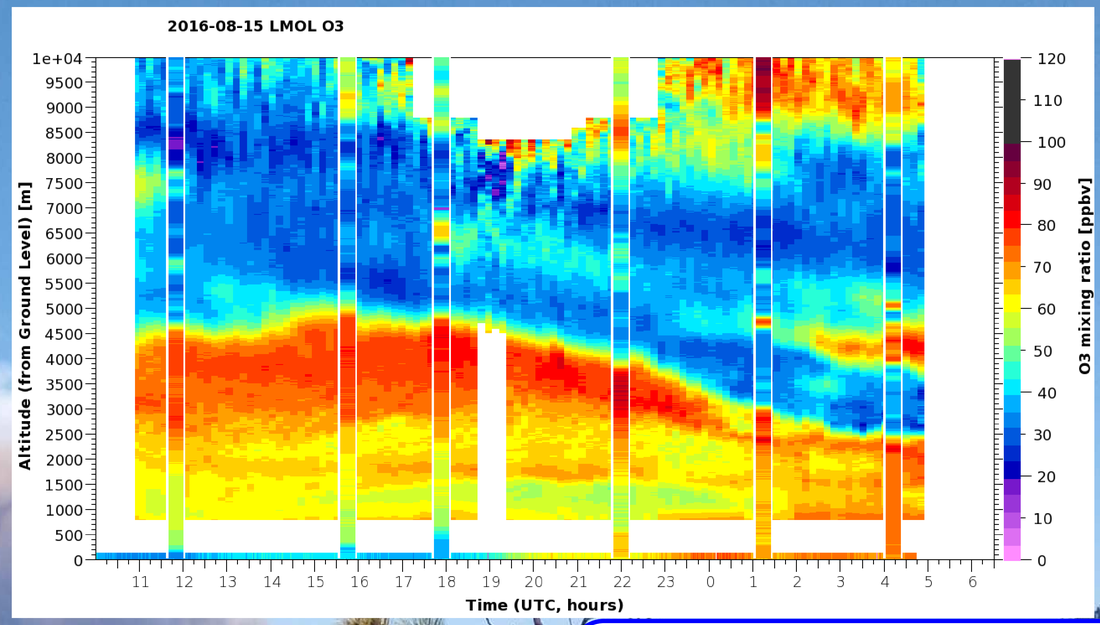
Abstract

The NASA's Langley Mobile Ozone Lidar (LMOL) system routinely measures tropospheric ozone and aerosol profiles, and is part of the Tropospheric Lidar Network (TOLNet). Recent upgrades to the system include a new pump laser that has tripled the transmission output power extending measurements up to 8 km in altitude during the day. In addition, software and algorithm developments have improved data output quality and enabled a real-time ozone display capability. In 2016, a number of ozone features were captured by LMOL, including the dynamics of an early-season ozone exceedance that impacted the Hampton Roads region. In this presentation, we will review current LMOL capabilities, recent air quality events observed by the system, and show a comparison of aerosol retrieval through the UV channel and the green line channel.



I -The NASA LMOL system

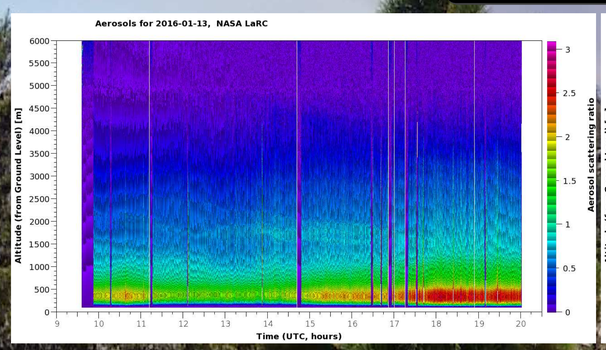
The LMOL system

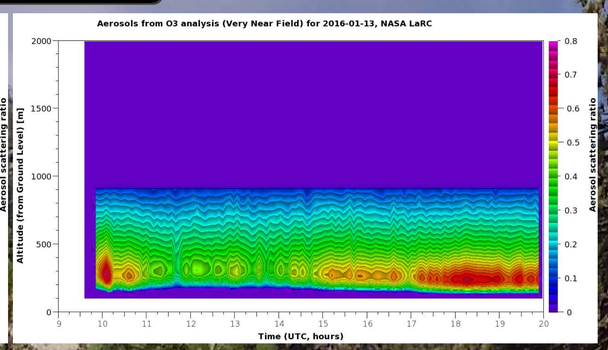
- Installed in a mobile trailer.
- Nd:YLF laser at 527 nm for Green Channel.
- Ce:LiCAF laser (pumped by Green) for UV.
- Tunable UV wavelength for DIAL: 286-292 nm.
- Licel receiver: Photon and Analog channels, for data between 600m and 10 km altitude.
- Analog channels for Green (aerosols) and Very Near Field.

Future Developments

- Very Near Field (100 m to 1 km).
- Additional Licel receiver.
- Autonomous system
- In-situ drone operation for validation of Very Near Field.
- Ozone Water-Land Environmental Transition Study (OWLETS) campaign in 2017.

II - Aerosol retrieval





Monitoring Aerosols with the Green Channel

The backscatter is retrieved using the Klett technique.

Monitoring Aerosols with the UV Channel

The backscattering is a product of the Aerosol correction for O_3 retrieval based on the Browell et al. (1985) technique. This technique assumes that we know the aerosol backscatter ratio. This ratio varies between the UV and the Green channel. There is therefore an unknown that prevent directly comparing the backscatter coefficient between the two channels. However, the agreement between the two channels of the variation of these coefficients is a proof of the technique. The correction of the O_3 from aerosols is still a problem since it requires 2 additional parameters that are not directly measured by our system.

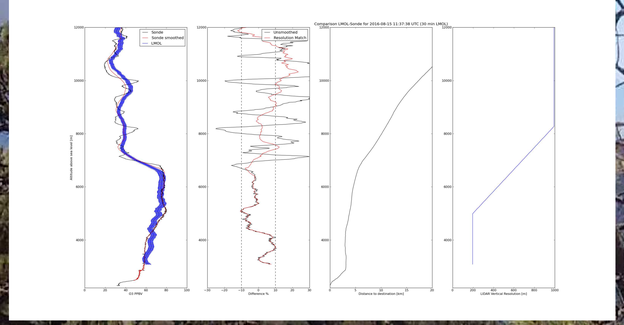
III- O_3 retrieval

Monitoring O_3 with the UV Channel

Ozone is retrieved using the DIAL technique (Browell et al. 1985). This technique is based on the difference of absorption of two UV lines due to O_3: one line is highly absorbed by ozone, the other less. A careful analysis is done taking into account the different sources of errors, such as Rayleigh absorption, aerosol absorption...

The LMOL retrieval algorithm computes the error following the scheme presented in the ISSI report by Leblanc et al. (2016). And adaptation of the smoothing (i.e. degradation of the resolution) is made based on these errors; we report our vertical resolution based on the ISSI report recommendations.

LMOL can be easily deployed in different locations, and therefore quickly assert air quality issues.

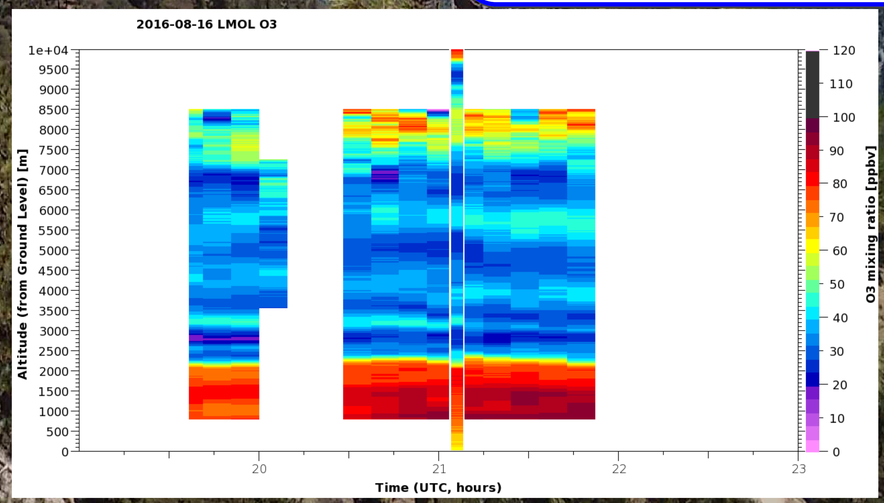


The SCOOP campaign

In August 2016, LMOL participated in the TOLNET/SCOOP campaign that happened at the JPL/TMF facility. Several O_3 lidar observations were compared against each other and ozone sondes. The above Figure shows the excellent comparison of LMOL with 6 Ozone Sondes (the missing data around 19h UTC/12h local corresponds to stray light from the Sun, and a minor servicing of the istrument). The left figure shows the detailed comparison of LMOL with the first ozone sonde.

O_3 Exceedance: The BLUE CUT Fire (Background) Observations

On 2016-08-16 the "Blue Cut Fire" started 20 km South West of the TMF facility. The different Lidar systems, and the ozone sonde, observed an increase in O_3 a few hundred meters above the surface, illustrating the ability of the system to detect O3 enhancements due to forest fire emissions.



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